METHOD OF FABRICATING AN EL MODULE AND METHOD OF REPAIRING A LIGHT EMITTING DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a method of fabricating and/or repairing an electroluminescence (EL) panel in which an electroluminescence (EL) element formed on a substrate is sealed between the substrate and a cover member. The Invention also relates to a method of repairing an EL module obtained by mounting an IC to the EL panel. The EL panel and the EL module are generically called light emitting devices in this specification.

2. Description of the Related Art

Being self-luminous, EL elements eliminate the need for a backlight that is necessary in liquid crystal display devices (LCDs) and thus make it easy to manufacture thinner displays. Also, the self-luminous EL elements are high in visibility and have no limit in terms of viewing angle. These are the reasons for attention that light emitting devices using the EL elements are receiving in recent years as electro-optical devices to replace CRTs and LCDs.

An EL element has a layer containing an organic compound that provides luminescence (electroluminescence) when an electric field is applied (the layer is hereinafter referred to as EL layer), in addition to a cathode layer and an anode layer. Luminescence obtained from organic compounds is classified into light emission upon return to a base state from singlet excitation (fluorescence) and light emission upon return to a base state from triplet excitation (phosphorescence). The repairing method of the present invention is applicable to a light emitting device whichever light

emission the device uses.

All the layers that are provided between an anode and a cathode are an EL layer in this specification. Specifically, the EL layer includes a light emitting layer, a hole injection layer, an electron injection layer, a hole transporting layer, an electron transporting layer, etc. A basic structure of an EL element is a laminate of an anode, a light emitting layer, and a cathode layered in this order. The basic structure can be modified into a laminate of an anode, a hole injection layer, a light emitting layer, and a cathode layered in this order, or a laminate of an anode, a hole injection layer, a light emitting layer, an electron transporting layer, and a cathode layered in this order.

In this specification, an EL element emitting light is expressed as an EL element being driven. The EL element as defined herein is a light emitting element comprising an anode, an EL layer, and a cathode.

In general, an EL element is fabricated by forming one of electrodes, namely, an anode or a cathode, then forming an EL layer so as to contact the electrode, and lastly forming the other electrode, a cathode or an anode, so as to contact the EL layer.

The EL layer is formed mainly by evaporation or spin coating. With either method, manufacturers take trouble to wash a substrate before forming the EL layer and the electrodes, throughly monitor the cleanliness in a clean room where the film formation takes place, and the like.

Despite those efforts, sometimes dusts land on the electrodes or other portions to open a hole (pin hole) in the formed EL layer. Fig. 12A shows a simplified sectional view of an EL element 200 in which two electrodes 201 and 202 short-circuit. If there is a pin hole formed in an EL layer 203, the two electrodes 201 and 202 can be connected to each other in the pin hole to short-circuit when the electrode 202 is formed on the EL layer 203. Hereinafter, a portion having a pin hole where two

layers sandwiching a light emitting layer are connected to each other is called a defect portion 204.

Fig. 13A shows the voltage-current characteristic of an EL element that has no defect portion whereas Fig. 13B shows the voltage-current characteristic of an EL element that suffers from short circuit at a defect portion.

Comparing Figs. 13A and 13B, the amount of current flowing in the EL element 200 when a reverse bias voltage is applied to the EL element 200 is larger in the case of Fig. 13B.

This is because two electrodes short-circuit in the defect portion 204 in the case of Fig. 13B unlike that of Fig. 13A and a current flows through the defect portion 204.

Short circuit of the two electrodes 201 and 202 taking place in the defect portion 204 reduces the luminance of light emitted from the EL layer. The current flow when a forward bias voltage is applied to the EL element having the defect portion is schematically shown in Fig. 12B.

When the two electrodes 201 and 202 short-circuit in the defect portion 204, the defect portion 204 supposedly has a resistance R_{SC} and connects the two electrodes of the EL element 200 to one another. Then, when a current flowing in the defect portion 204 is given as I_{SC} and a current flowing in the EL layer 203 is given as I_{dio}, a forward current I_{on} caused to flow from one of the electrodes of the EL element satisfies the following equation:

$$I_{on} = I_{SC} + I_{dio}$$

Therefore, when I_{on} is constant in the above equation $I_{on} = I_{SC} + I_{dio}$, the current I_{dio} that actually flows in the EL layer 203 is reduced in the EL element having the defect portion. This tendency is enhanced when the resistance R_{SC} in the defect portion 204 is small and I_{SC} is accordingly large, thereby increasing the need for rectification